

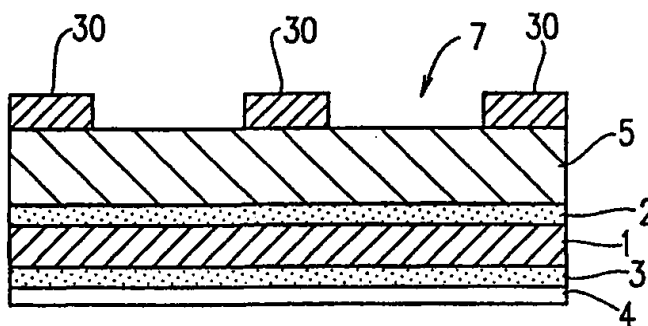


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(54) Title: WAFER RETAINER AND METHOD FOR ATTACHING/DETACHING THE WAFER RETAINER TO/FROM POLISHING MACHINE BASE PLATE		
(57) Abstract <p>A wafer retainer includes: a foam layer capable of adsorbing a wafer on a surface thereof in a detachable manner; a first pressure-sensitive adhesive layer formed on a back face of the foam layer; a support formed on a back face of the first pressure-sensitive adhesive layer; a second pressure-sensitive adhesive layer formed on a back face of the support for adhering to a base plate of a polishing machine; and a release sheet releasably attached to the second pressure-sensitive adhesive layer. The second pressure-sensitive adhesive layer includes an adhesive composition. The adhesive composition contains a pressure-sensitive adhesive and a side-chain crystallizable polymer so that the side-chain crystallizable polymer is present in an amount of about 1 % to about 30 % by weight based on the adhesive composition. The side-chain crystallizable polymer includes as a main component thereof an acrylic acid ester and/or methacrylic acid ester which has a straight-chain alkyl group including 16 or more carbon atoms as a side-chain.</p>		



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DESCRIPTION

WAFER RETAINER AND

5 METHOD FOR ATTACHING/DETACHING THE WAFER RETAINER TO/FROM
POLISHING MACHINE BASE PLATE

TECHNICAL FIELD

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The present invention relates to a wafer retainer which is attached to a base plate of a polishing machine so as to hold a workpiece (e.g., a semiconductor wafer) in place while the workpiece is polished, and a method for
15 attaching/detaching the wafer retainer to/from the base plate of the polishing machine.

BACKGROUND ART

20

In recent years, in the semiconductor industry, the integration level of ICs has rapidly increased. It has increased from 4M to 16M and is now proceeding to the 64M level.

25

In light of the above circumstances, improvement in the surface quality of a wafer (on which ICs are formed) has been demanded. In order to increase the integration level of ICs, it is necessary to reduce the minimum width
30 that is allowed for devices to be mounted on the wafer, as well as improving the chemical and electrical properties of the wafer. The ideal value for the minimum width has shifted from about 0.5 microns to about 0.35 microns.

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In order to enable such high-precision processing, more and more stringent demands have been made on the flatness or thickness accuracy of the wafer surface. Specifically, a wafer which has been subjected to a final mirror-surface polishing process is required to have a total thickness variation (TTV) on the order of 1 μm or less over the entire area, and a local thickness variation (LTV) on the order of 0.2 μm or less over an area of about 20 mm^2 (i.e., an area generally defining a single IC chip).

In order to satisfy such accuracy requirements, it is necessary to accurately mount a given wafer to be polished on a base plate of a polishing machine so that the wafer is substantially in parallel with respect to the base plate surface. In general, two conventional methods are used for mounting a wafer on a polishing machine base plate.

One method involves applying a fused wax on the surface of a heated base plate so as to allow the wafer to be fixed on the base plate surface via the applied wax.

According to this method, a wafer is first fixed on the base plate surface to carry out a polishing process; after the polishing process is completed, the base plate is heated again to fuse the wax thereon in order to remove the wafer from the base plate surface; and the wafer is washed with an organic solvent to eliminate the wax.

Although this method can provide a satisfactory small level of thickness variation of polished wafers, it requires one heating/cooling step of the base plate before and after polishing. Thus, this method disadvantageously

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requires a heating step for causing thermal fusing of wax,
and hazardous organic solvents for washing off the wax.

Another method for mounting a wafer on a polishing
5 machine base plate involves the use of a wafer retainer,
such that the wafer retainer is previously adhered to an
upper base plate of a polishing machine, and a wafer is
adsorbed to the surface of the wafer retainer via a liquid
such as water. This method facilitates a polishing process
10 in terms of attachment/detachment of a wafer to/from a base
plate, and therefore provides high efficiency and is
suitable for automation. Such a wafer retainer is usually
fixed on a polishing machine upper base plate by using a
pressure-sensitive adhesive having high tack strength.

15

In this mounting method, however, the adhesive layer
provided on the back face of the wafer retainer substrate
is adhered to the base plate surface so firmly that a tack
strength as large as about 2 to 3 kg/inch width exists when
20 the wafer retainer thus attached to the base plate must be
detached in a usual manner. In other words, a force up to
about 57 kg may be required to detach a wafer retainer from
a base plate having a diameter of about 485 mm. Thus, it
is very troublesome when a used wafer retainer must be
25 exchanged with a new one.

On the other hand, if a wafer retainer fails to be
attached in proper alignment with respect to the base plate,
it has been difficult to reposition and reattach the wafer
30 retainer.

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DISCLOSURE OF THE INVENTION

A wafer retainer according to the present invention includes: a foam layer capable of adsorbing a wafer on a surface thereof in a detachable manner; a first pressure-sensitive adhesive layer formed on a back face of the foam layer; a support formed on a back face of the first pressure-sensitive adhesive layer; a second pressure-sensitive adhesive layer formed on a back face of the support for adhering to a base plate of a polishing machine; and a release sheet releasably attached to the second pressure-sensitive adhesive layer, wherein the second pressure-sensitive adhesive layer includes an adhesive composition, the adhesive composition containing a pressure-sensitive adhesive and a side-chain crystallizable polymer so that the side-chain crystallizable polymer is present in an amount of about 1% to about 30% by weight based on the adhesive composition, and the side-chain crystallizable polymer including as a main component thereof an acrylic acid ester and/or methacrylic acid ester which has a straight-chain alkyl group including 16 or more carbon atoms as a side chain.

In one embodiment of the invention, the adhesive composition contains a tackifier in an amount of about 10% to about 30% by weight; and adhesiveness of the adhesive composition is decreased by more than about 90% when heated above about 50°C.

In another embodiment of the invention, the side-chain crystallizable polymer has a molecular weight of about 2,000 to about 15,000.

- 5 -

In still another embodiment of the invention, the side-chain crystallizable polymer has a melting point which occurs within a temperature range narrower than about 15°C.

5 Alternatively, the wafer retainer according to the present invention includes: a wafer retention layer capable of adsorbing a wafer on a surface thereof in a detachable manner; a pressure-sensitive adhesive layer for attaching
10 the wafer retention layer to a base plate of a polishing machine; and a release sheet releasably attached to the pressure-sensitive adhesive layer, wherein the pressure-sensitive adhesive layer includes an adhesive composition, the adhesive composition containing a
15 pressure-sensitive adhesive and a side-chain crystallizable polymer so that the side-chain crystallizable polymer is present in an amount of about 1% to about 30% by weight based on the adhesive composition, and the side-chain crystallizable polymer including as a
20 main component thereof an acrylic acid ester and/or methacrylic acid ester which has a straight-chain alkyl group including 16 or more carbon atoms as a side chain.

 In one embodiment of the invention, the adhesive composition contains a tackifier in an amount of about 10%
25 to about 30% by weight; and adhesiveness of the adhesive composition is decreased by more than about 90% when heated above about 50°C.

 In another embodiment of the invention, the
30 side-chain crystallizable polymer has a molecular weight of about 2,000 to about 15,000.

In still another embodiment of the invention, the

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side-chain crystallizable polymer has a melting point which occurs within a temperature range narrower than about 15°C.

5 In another aspect of the invention, there is provided a method for attaching/detaching any of the above wafer retainers to/from a base plate of a polishing machine, including the steps of: attaching the wafer retainer to the base plate of the polishing machine by allowing the pressure-sensitive adhesive of the wafer retainer to adhere
10 to the base plate surface maintained at temperature T1; and detaching the wafer retainer from the base plate maintained at temperature T2 which is higher than temperature T1.

15 The present invention provides the following effects.

According to one embodiment of the present invention, a wafer retainer is provided which includes a pressure-sensitive adhesive layer composed essentially of an adhesive
20 composition containing a pressure-sensitive adhesive and a side-chain crystallizable polymer, where the side-chain crystallizable polymer is present in the amount of about 1% to about 30% by weight based on the adhesive composition. The side-chain crystallizable polymer includes as a main
25 component thereof an acrylic acid ester and/or methacrylic acid ester which has a straight-chain alkyl group including 16 or more carbon atoms as a side chain. As a result, the polymer is capable of shifting between a crystal state and an amorphous state in a reversible manner, responsive to
30 a relatively small temperature change from an arbitrarily selected ordinary temperature value; consequently, the polymer exhibits drastic a change in its tackiness to the base plate surface.

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Thus, when the wafer retainer is heated to a predetermined elevated temperature (e.g., about 50°C to about 100°C), the adhesiveness of the adhesive layer rapidly decreases. Therefore, at the time of exchanging wafer retainers, the base plate and/or the wafer retainer may be heated so as to greatly decrease the adhesiveness of the adhesive layer with respect to the base plate surface, whereby the wafer retainer can be easily peeled off the base plate surface.

In accordance with an embodiment of the invention where the adhesive composition contains a tackifier in the amount of about 10% to about 30% by weight and where the adhesiveness of the adhesive composition is decreased by more than about 90% when heated above about 50°C, a predetermined level of adhesiveness with respect to the base plate surface can be retained at ordinary temperatures, whereas a rapid decrease in adhesion strength can be caused by heating. Thus, a tackifier present in the above-mentioned amount will not substantially influence the temperature sensitivity of the polymer. As a result, the adhesive composition according to the present invention exhibits a sufficient adhesion strength at ordinary temperatures, while maintaining a good balance between the adhesion strength at ordinary temperatures and the peeling force required at elevated temperatures.

Thus, the invention described herein makes possible the advantages of (1) providing a wafer retainer which adheres strongly, stably, and precisely to a base plate of a polishing machine while a wafer or the like is polished with the wafer retainer, and yet allows for easy detachment

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from the base plate; (2) providing a method for attaching/detaching such a wafer retainer to/from a base plate of a polishing machine; (3) providing a wafer retainer which can be easily repositioned and reattached for proper alignment with respect to a base plate of a polishing machine; and (4) providing a method for attaching/detaching such a wafer retainer to/from a base plate of a polishing machine.

These and other advantages of the present invention will become apparent to those skilled in the art upon reading and understanding the following detailed description with reference to the accompanying figures.

15

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a cross-sectional view illustrating a double-sided adhesive tape used for producing a wafer retainer according to the present invention.

Figure 2A is a cross-sectional view illustrating a wafer retainer according to one example of the present invention.

25

Figure 2B is a cross-sectional view illustrating a wafer retainer according to another example of the present invention.

Figure 3 is a cross-sectional view illustrating a wafer retainer according to the present invention being attached to an upper base plate of a polishing machine.

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Figure 4 is a cross-sectional view illustrating an essential portion of Figure 3.

5 Figure 5 is a cross-sectional view illustrating a backing film.

10 Figure 6 is a cross-sectional view illustrating a buffed state of the surface layer of a foam layer of the backing film shown in Figure 5.

15 Figure 7 is a cross-sectional view illustrating a backing film with a double-sided adhesive tape according to the present invention.

15

BEST MODES FOR CARRYING OUT THE INVENTION

20 Referring to Figure 2B, the wafer retainer 7 of the present invention at least includes: a foam layer (hereinafter also referred to as a "wafer retention layer") 5 which is capable of adsorbing a wafer on its surface in a detachable manner; a pressure-sensitive adhesive layer 3 for attaching the foam layer 5 on the surface of a base plate of a polishing machine; and a release sheet 4 releasably
25 attached to the pressure-sensitive adhesive layer 3.

30 The wafer retainer 7 may be composed of three layers as described above, or alternatively may include additional layers. For example, the wafer retainer 7 may have a five-layered structure as shown in Figure 2A. In this case, the wafer retainer 7 may include a first pressure-sensitive adhesive layer 2 (which can be composed of a commercially available adhesive) formed on one face of a support sheet 1,

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a wafer retention layer (foam layer) 5 formed on the surface of the first pressure-sensitive adhesive layer 2, a second pressure-sensitive adhesive layer 3 (composed of the inventive pressure-sensitive adhesive) formed on the other face of the support 1, and a release sheet 4 attached on the second pressure-sensitive adhesive layer 3.

As the support sheet 1, various synthetic resin sheets can be used, e.g., polyethylene terephthalate, polyether imide, or polyurethane. For example, a polyester film designated "Lumirror" (manufactured by Toray Industries, Inc.) may be used.

The foam layer (wafer retention layer) 5 may be formed as follows, for example: A foam composition containing urethane polymer, vinyl polymer (such as vinyl chloride polymer, vinyl chloride-vinyl acetate copolymer, and vinyl chloride-vinyl acetate-vinyl alcohol ternary polymer), and a suitable foam solvent such as dimethylformaldehyde may be used to form a foam layer on the above-mentioned support by the wet solidification method. The surface area of the foam layer, especially a skin layer formed on the surface, is preferably subjected to buffing so as to facilitate adsorption of a wafer attached thereon.

25

(Pressure-sensitive Adhesive layer)

The second pressure-sensitive adhesive layer used for the present invention is formed directly or indirectly on the back face of the wafer retention layer. In the case where the second pressure-sensitive adhesive is formed indirectly on the back face of the wafer retention layer, a common pressure-sensitive adhesive layer (first pressure-sensitive adhesive layer) and a support may be

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interposed between the second pressure-sensitive adhesive layer and the back face of the wafer retention layer.

Examples of pressure-sensitive adhesives contained
5 in the adhesive composition composing the second
pressure-sensitive adhesive layer include the following
materials: natural rubber adhesives; styrene/butadiene
latex-base adhesives; ABA block copolymer type
thermoplastic rubbers (where A represents a thermoplastic
10 polystyrene end block; and B represents a rubber
intermediate block such as polyisoprene, polybutadiene or
poly(ethylene/butylene)); butyl rubber; polyisobutylene;
acrylic adhesives such as polyacrylate and vinyl
acetate/acryl ester copolymer; and vinylether copolymers
15 such as polyvinylmethylether, polyvinylethylether, and
polyvinylisobutylether.

Especially preferable are acryl type pressure-
sensitive adhesives composed essentially of ethylhexyl
20 acrylate, hydroxyethyl acrylate, or the like. The use of
acryl type pressure-sensitive adhesives provides
interaction with the polymer such that the polymer will so
be sufficiently dispersed within the adhesive layer at a
predetermined temperature so as to exhibit sufficient
25 tackiness, and yet that the polymer will easily bleed out
when heated to a temperature above the predetermined
temperature.

(Side-chain Crystallizable Polymer)

30 As a side-chain crystallizable polymer to be
contained in the adhesive composition, those which have a
melting point which occurs within a temperature range
narrower than about 15°C (also referred to as "first-order

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melting transition") are preferably used. An adhesive composition containing such a polymer is disclosed in Japanese National Phase PCT Laid-open Publication No. 6-510548.

5

As used herein, the term "melting point" means the temperature at which an equilibrium process causes certain portions of a polymer, initially aligned in an ordered array, to become disordered. In one embodiment, preferably, the melting point of the polymer is in the range of about 40°C to about 100°C, more preferably in the range of about 40°C to 60°C. It is preferable that the melting occur rapidly, i.e., over a relatively narrow temperature range which is less than about 10°C and preferably less than about 5°C. It is preferable that the polymer crystallizes rapidly. To this end, seeding agents, or crystallization catalysts can be incorporated into the polymer.

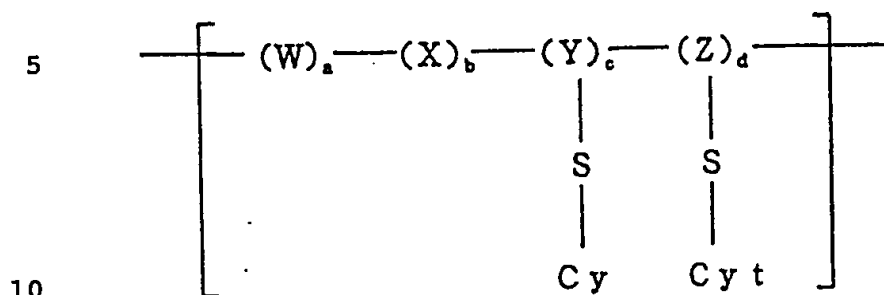
After use, the wafer retainer according to the present invention can be readily peeled off the surface of the polishing machine base plate by simply heating the wafer retainer to a temperature (hereinafter referred to as an "elevated temperature") which is slightly higher than the use temperature. The elevated temperature is usually about 40°C to about 100°C, preferably about 40°C to about 60°C.

The present invention is based on the finding that it is possible to obtain an adhesive composition whose adhesiveness controllably varies with temperature by mixing a crystallizable polymer of certain physicochemical properties with a pressure-sensitive adhesive.

The most preferable side-chain crystallizable

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polymer to be used according to the present invention contains repeating units of the formula below:



....(I)

15 In formula (I), W and X represent first and second monomer units, respectively, each of which may be any molecular moiety connectable to an adjoining molecular moiety (i.e., polymerizable). Y and Z each independently represent a backbone monomer unit which may be any molecular moiety or atom. Each S independently represents a linking group or spacer unit which may optionally be present. Cyt and Cy each independently represent a crystallizable moiety which is connected to the respective backbone either directly or via the spacer unit. Variables a, b, c, and d each independently represent an integer in the range of 0 to 1,000 with the proviso that sufficient Cyt and Cy are present so as to provide a molecular weight which is equal to or greater than twice the sum of the molecular weights of W, X, Y and Z. The polymers have a heat of fusion (Δ Hf) of at least about 20 Joules/g. In the case where variables a, b, c, and d are all greater than 1, monomer units W, X, Y, and Z each define a repeating unit or a mixture of different monomer units. For example, in the case where

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a is 100, W may be a 5:5:2:5:83 mixture of styrene, acrylic acid, methylstyrene, and hexadecylacrylate. Accordingly, any of monomer units W, X, Y, and Z may be a mixture of polymerizable monomers.

5

The adhesive composition according to the present invention may optionally be cross-linked. Cross-linking may be effected by any known technique, such as using a cross-linking agent, heating, or radiation.

10

The backbone of the polymer (represented as W, X, Y, and Z in formula (I)) may be any organic structure (aliphatic or aromatic hydrocarbon, ester, ether, amide, etc.) or an inorganic structure (sulfide, phosphazine, silicone, etc.). The spacer linkages can be any suitable organic or inorganic units, for example, ester, amide, hydrocarbon, phenyl, ether, or inorganic salt (e.g., a carboxyl-alkyl ammonium or sulphonium or phosphonium ion pair, or other known ionic salt pair). The side-chain (represented as Cyt and Cy, and an optionally present S in formula (I)) may be aliphatic or aromatic, or a combination of aliphatic side-chains of at least 10 carbon atoms, fluorinated aliphatic side-chains of at least 6 carbon atoms, and p-alkyl styrene side-chains wherein the alkyl group contains 8 to 24 carbon atoms.

25

The length of each side-chain moiety is usually greater than about 5 times the distance between side-chains in the case of acrylates, methacrylates, vinyl esters, acrylamides, methacrylamides, vinyl ethers, and alpha olefins. In the extreme case of a fluoroacrylate alternate copolymer with butadiene, a side-chain can be as little as 2 times the length of the distance between branches. In any

30

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case, the side-chain unit should account for more than about 50% of the volume of the polymer, preferably greater than about 65% of the volume. Co-monomers added to a side-chain polymer usually have an adverse effect on crystallinity.

5 Small amounts (usually about 10% to about 25% by volume) of various comonomers can be tolerated. In some cases, it may be preferable to add a small amount of comonomer, e.g., a cure site monomer such as acrylic acid, glycidal methacrylate, maleic anhydride, an amino functional monomer,

10 and the like.

Examples of side-chain crystallizable monomers which fall within the above-described categories include acrylate, fluoroacrylate, methacrylate and vinyl ester

15 polymers such as those described in J. Poly. Sci. 10: 3347 (1972); J. Poly. Sci. 10: 1657 (1972); J. Poly. Sci. 9: 3367 (1971); J. Poly. Sci. 9: 3349 (1971); J. Poly. Sci. 9: 1835 (1971); J.A.C.S. 76: 6280 (1954); J. Poly. Sci. 7: 3053 (1969); J. Poly. Sci. 17: 991 (1985), corresponding

20 acrylamides, substituted acrylamide and maleimide polymers (J. Poly. Sci.: Poly. Physics Ed. 18: 2197 (1980); poly(α -olefin) polymers such as those described in J. Poly. Sci.: Macromol. Rev. 8: 117-252 (1974) and Macromolecules 13: 12 (1980), polyalkyl-vinylethers, polyalkylethylene oxides

25 such as those described in Macromolecules 13: 15 (1980), alkylphosphazene polymers, polyamino acids such as those described in J. Poly. Sci. USSR 21: 241 (1979), Macromolecules 18: 2141(1985), polyisocyanates such as those described in Macromolecules 12: 94 (1979),

30 polyurethanes made by reacting amine- or alcohol-containing monomers with long-chain alkyl isocyanates, polyesters and polyethers, polysiloxanes and polysilanes such as those described in Macromolecules 19: 611 (1986), and p-

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alkylstyrene polymers such as those described in J.A.C.S. 75: 3326 (1953), and triglycerides such as tristearin or pentaerythritol tetrastearate.

5 Particularly preferable side-chain crystallizable polymers to be used for the present invention include linear aliphatic C14-C50 (having 14 to 50 carbon atoms) polyacrylates, linear aliphatic C14-C50 polymethacrylates, linear aliphatic C14-C50 polyacrylamides, and linear
10 aliphatic C14-C50 polymethacrylamides. Especially preferable among these are linear aliphatic C16-C22 polyacrylates, linear aliphatic C16-C22 polymethacrylates, linear aliphatic C16-C22 polyacrylamides, and linear aliphatic C16-C22 polymethacrylamides.

15 As described above, the melting point of the selected crystallizable polymer defines a use temperature range, within which the composition exhibits tackiness. The amount of the crystallizable polymer incorporated in
20 the adhesive composition has surprisingly little effect on the position or the breadth of this range.

 The transition temperatures of some selected side-chain crystallizable polymers are listed below:

25	polymer	transition temperature (°C)
	C16 acrylate	36
	C16 methacrylate	26
30	C18 acrylate	49
	C18 methacrylate	39
	C20 acrylate	60
	C20 methacrylate	50

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C22 acrylate	71
C22 methacrylate	62

See E. F. Jordan et al. "SIDE-CHAIN CRYSTALLIZATION
5 DEGREE II", J. Poly. Sci. Section A-1, 9: 33551 (1971).
Examples in this literature describe a method for producing
a crystallizable polymer in detail.

10 The molecular weight of the crystallizable polymer
to be used is an important factor that determines the manner
in which the adhesive composition of the present invention
exhibits temperature-dependent tackiness and/or adhesion
strength. Specifically, a low molecular weight
15 crystallizable polymer will advantageously lose bonding
strength when heated. If such property is desirable, the
molecular weight of the polymer is preferably in the range
of 2,000 to 15,000, and more preferably in the range of 3,000
to 10,000.

20 The adhesive compositions useful for the present
invention may contain, in addition to one or more of the
polymers described above, conventional additives such as
tackifiers (wood rosin, polyesters, etc.), antioxidants,
fibrous or non-fibrous fillers, colorants, and the like.
25 It is also possible to include additional adhesives in the
adhesive composition so long as the overall temperature
sensitivity profile is not significantly affected thereby.
The amount of crystallizable polymer in the adhesive
composition is preferably in the range of about 1% by weight
30 to about 30% by weight, more preferably in the range of about
5% by weight to about 20% by weight, and in particular in
the range of about 5% by weight to about 15% by weight. If
the polymer content in the adhesive composition is less than

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about 1% by weight or more than about 30% by weight, the above-described effects of the polymer may not be exhibited.

5 The adhesive compositions of the present invention may be prepared by admixing a pressure-sensitive adhesive and a crystallizable polymer in a compatible solvent and adding optional components thereto, e.g., a plasticizer, a tackifier, and/or a filler. The solid contents are adjusted to the desired viscosity, and the mixture is blended
10 until it is homogeneous. After blending, bubbles are removed from the mixture.

 Examples of tackifiers include special rosin ester type tackifiers, terpene phenol type tackifiers, petroleum
15 resin type tackifiers, high hydroxyl value rosin ester type tackifiers, hydrogenated rosin ester type tackifiers, and the like. Examples of commercial products include a special rosin ester type tackifier designated Super Ester A125 (Arakawa Chemical K.K.), a terpene phenol type tackifier
20 designated Tamanoru 803L (Arakawa Chemical K.K.), a petroleum resin type tackifier designated Hiresin #90S (Toho Chemical Industry Co. Ltd.), a high hydroxyl value rosin ester type tackifier designated KE-364C (Arakawa Chemical K.K.), and a hydrogenated rosin ester type tackifier
25 designated Estergum HD (Arakawa Chemical K.K.).

 Particularly preferable are, special rosin ester type tackifiers. The amount of a tackifier to be added is preferably in the range of about 10% to about 30% by weight,
30 more preferably about 15% to about 25%, based on the adhesive composition. If the tackifier content is less than about 10% by weight, sufficient adhesion strength may not be attained at ordinary temperatures. If the tackifier

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content is more than about 30% by weight, the rate of decrease of adhesion strength may not be sufficient at the time of peeling.

5 Preferable examples of a polymer contained in the adhesive composition include the following:

10 (1) a copolymer of 80 to 98 parts by weight of stearyl acrylate, 2 to 20 parts by weight of acrylic acid, and 2 to 10 parts by weight of dodecylmercaptan;

15 (2) a copolymer of 5 to 90 parts by weight of dococyl acrylate, 5 to 90 parts by weight of stearyl acrylate, 1 to 10 parts by weight of acrylic acid, and 2 to 10 parts by weight of dodecylmercaptan; and

20 (3) a copolymer of 80 to 98 parts by weight of dococyl acrylate, 2 to 20 parts by weight of acrylic acid, and 2 to 10 parts by weight of dodecylmercaptan.

25 Examples of pressure-sensitive adhesives to be contained in the adhesive composition include a copolymer containing 80 to 95 parts by weight of 2-ethylhexyl acrylate and 5 to 20 parts by weight of 2-hydroxyethyl acrylate.

30 A number of methods can be used to provide the adhesive layers on a support (or wafer retention layer), e.g., spray deposition, painting, dipping, gravure printing, rolling or the like. The adhesive layers may also be transferred from a release sheet, as in the manner of transfer printing. The composition may be applied neat (i.e., without anything else), or in a suitable solvent, or as an emulsion or latex. Alternatively, a mixture of

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appropriate monomers and additives may be applied directly to a wafer retention layer and cured in situ by heat, irradiation, or other suitable processes known in the art.

5 In the case of composing the wafer retainer of four or more layers, the above-described second pressure-sensitive adhesive layer and a first pressure-sensitive adhesive layer (which may be composed of a commercially available adhesive) may be laminated on either face of a
10 support, and a wafer retention layer may be further adhered to the first pressure-sensitive adhesive layer. As the first pressure-sensitive adhesive, the second pressure-sensitive adhesive may be used, for example; however, any other adhesive, in particular a rubber type adhesive, an
15 acrylic type adhesive, or a semi-hotmelt adhesive can be used.

 The wafer retainer produced in the above-described manner can be attached to a base plate of a polishing machine
20 as follows. First, the polishing machine base plate is removed and cleaned. At an ordinary temperature (usually about 25°C), the base plate is placed horizontally, with the face for attaching the wafer retainer facing up. The wafer retainer is taken out from its package (if any), and the
25 release sheet is removed to reveal its adhesive face (i.e., the second pressure-sensitive adhesive layer), which is gently abutted with the base plate surface. It is preferable to slightly warp the wafer retainer and gently place it on the base plate so that its central portion contacts the base
30 plate first. Thereafter, a uniform pressure is applied from above on the entire surface of the wafer retainer thus situated. Although any pressing method may be employed, the press force is preferably equal to or smaller than 1 kg/cm².

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A pressing method may be adopted which involves pressing the wafer retainer with a flat plate while interposing a sufficient thickness of elastic material between the wafer retainer and the flat plate. Most preferably, a plastic sheet may be employed to cover the wafer retainer situated as described above, and thereafter the space under the plastic sheet may be vacuumed to attain a negative pressure.

As a result, the adhesive layer on the back face of the wafer retainer develops intimacy with the base plate face for close contact. A tack strength on the order of 2 to 3 kg/inch width would exist when the wafer retainer thus attached to a polishing machine base plate were to be detached in a usual manner.

After attaching the wafer retainer on a polishing machine base plate in any of the above-described manners, the base plate carrying the wafer retainer attached thereto may be heated to an elevated temperature above about 50°C, for example.

Following heating methods can be used, for example:

(1) Methods for heating the wafer retainer surface

These methods may involve application of a heated iron, hot water, a heater sheet, hot air (e.g., from an air heater or a drier), steam, radiofrequency heating, and/or irradiation (infrared or far-infrared) by means of a lamp, for example.

(2) Methods for applying heat at the interface between the wafer retainer and the base plate

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These methods may involve application of a heated trowel, a heated iron, hot air (e.g., from an air heater or a drier), hot water, steam, and/or irradiation (infrared or far-infrared) by means of a lamp, for example.

5

Thereafter, the wafer retainer is peeled off the base plate while heating the wafer retainer. Since the peeling force at the elevated temperature is decreased to about 0.1 to about 0.5 Kg/inch width, the wafer retainer of the present invention can be easily peeled off the base plate surface. The peeling of the wafer retainer may be performed manually.

Hereinafter, the present invention will be specifically described by way of illustrative examples. In the following description, any reference to "part(s)" means "part(s) by weight".

A. Preparation of polymer

20

(Synthesis Example 1)

First, 95 parts of stearyl acrylate, 5 parts of acrylic acid, 5 parts of dodecylmercaptan, and 1 part of Kayaester HP-70 (Kayaku Akzo K.K.) were mixed. The mixture was stirred at about 80°C for about 5 hours to polymerize these monomers. The resultant polymer had a molecular weight of about 8,000, and a melting point of about 50°C.

25

(Synthesis Example 2)

First, 95 parts of dococyl acrylate, 5 parts of acrylic acid, 5 parts of dodecylmercaptan, and 1 part of Kayaester HP-70 (Kayaku Akzo K.K.) were mixed. The mixture was stirred at about 80°C for about 5 hours to polymerize

30

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these monomers. The resultant polymer had a molecular weight of about 8,000, and a melting point of about 60°C.

(Synthesis Example 3)

5 First, 92 parts of 2-ethylhexyl acrylate, 8 parts of hydroxyethyl acrylate, and 0.3 parts of Trigonox 23-C70 (Kayaku Akzo K.K.) were mixed in 150 parts of ethyl acetate/heptane (70/30). The mixture was stirred at 55°C for 3 hours and heated to about 80°C, and 0.5 parts of
10 Kayaester HP-70 was added. The mixture was stirred for about 2 hours to polymerize these monomers. The resultant polymer had a molecular weight of about 600,000.

15 B. Preparation of a wafer retainer with a double-sided adhesive tape

(Example 1)

The polymers obtained in accordance with Synthesis Examples 1 and 3 were mixed at a ratio of 10: 100 parts.
20 To the resultant polymer solution, a cross-linking agent designated Coronate L45 (Nippon Polyurethane Industry Co., Ltd.) was added so that 0.3 parts of Coronate L45 was present against 100 parts of the polymer of Synthesis Example 3. As shown in Figure 1, the resultant mixture was coated on
25 one face of a support 1 (a PET film manufactured by Somar Co.) so as to have a thickness of about 40 µm, thereby forming an adhesive layer 3. On the other face of the support 1, a rubber type pressure-sensitive adhesive designated G5109A (NO-TAPE Industrial Co., Ltd.) was coated so as to have a
30 thickness of about 40 µm, thereby forming a pressure-sensitive adhesive 2. Thus, a double-sided adhesive tape was produced. Furthermore, release sheets 4 were laminated on the adhesive layers 2 and 3 to give a double-sided

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adhesive tape 6 with release lining as shown in Figure 1.

As shown in Figure 5, a mixture I (as described in Table 3) was coated on a polyester film 5c (Lumirror manufactured by Toray Industries, Inc.; having a thickness of about 188 μm) so as to have a thickness of about 700 μm , and was subjected to a wet solidification method to form a foam layer 5b. The resultant composite was subjected to washing and drying to give a backing film. The outermost 100 μm (indicated as 5a in Figure 5) of this backing film was ground to give the backing film shown in Figure 6.

The double-sided adhesive tape 6 was attached to the polyester film 5c of the backing film to give a backing film 5 with a double-sided adhesive tape.

Next, the backing film 5 with a double-sided adhesive tape was cut into a piece having a diameter of about 485 mm. A template 30 having recesses for positioning or retaining a wafer in place was attached on the backing film 5 by means of a press, thereby producing a wafer retainer 7 with a double-sided adhesive tape as shown in Figure 2A. The template 30 used herein was a piece of glass epoxy having an outer diameter of about 485 mm provided with seven 6-inch pockets, with an adhesive and a release sheet on one face.

Next, as shown in Figure 3, the release sheet 4 on the wafer retainer 7 (Figure 2A) was peeled, and thereafter the pressure-sensitive adhesive layer 3 was attached to an upper base plate 10 of a polishing machine, thereby lightly attaching the wafer retainer 7 to the upper base plate. Thereafter, a quartz flat (weight: 10 kg; outer diameter: 485 mm) was uniformly placed on the wafer retainer 7, and

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left for about 30 minutes to develop intimacy between the adhesive and the upper base plate 10. The adhesion temperature was about 25 °C. In Figure 3, reference numeral 11 denotes a wafer; 12 denotes a lower base plate; and 13 denotes a polishing cloth attached on the lower base plate 12.

Next, the wafer retainer was evaluated by using a single-side polishing machine (SPM-19, manufactured by Fujikoshi Kikai). Wafers 11 of silicon monocrystal P (100) (diameter: 6 inches) were subjected to a polishing under the polishing conditions described in Table 4. Specifically, fifty times of polishing (about 30 minutes each time) were repetitively performed.

After the wafer retainer 7 was used in the above-mentioned manner, the upper base plate 10 was immersed in hot water at about 60°C, and the wafer retainer 7 was peeled off the upper base plate after the lapse of about 10 minutes. The wafer retainer 7 easily peeled with a maximum peeling force of about 3 Kg.

After the adhesive layer 3 of the wafer retainer 7 was once attached to the upper base plate of the polishing machine, it was possible to easily reposition and reattach the wafer retainer 7 by heating above about 60°C.

(Examples 2 to 4)

A wafer retainer with a double-sided adhesive tape was produced in the same manner as in Example 1 except that Superester A125 (Arakawa Chemical K.K.) was added as a tackifier in the amount of about 10% by weight (Example 2), about 20% by weight (Example 3), or about 30% by weight

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(Example 4), based on the polymer of Synthesis Example 3.

Next, the same polishing test as that in Example 1 was conducted, whereafter each wafer retainer was peeled.
5 Each wafer retainer easily peeled with a maximum peeling force of about 3.5 Kg.

Table 2 shows the added amounts of Superester A125, the peeling forces at an ordinary temperature (about 23°C) and at an elevated temperature (about 60°C), and the rate of decrease of the peeling force from the value exhibited at the elevated temperature relative to the value exhibited at the ordinary temperature.

15 (Examples 5 to 8)

A wafer retainer with a double-sided adhesive tape was produced in the same manner as in Example 1 except that the polymers of Synthesis Examples 2 and 3 were mixed at the ratio of about 10: 100 parts and that Superester A125
20 (Arakawa Chemical K.K.) was added as a tackifier in the amount of about 0% by weight (Example 5), about 10% by weight (Example 6), about 20% by weight (Example 7), or about 30% by weight (Example 8), based on the polymer of Synthesis Example 3.

25

Next, the same polishing test as that in Example 1 was conducted, whereafter each wafer retainer was peeled. Table 2 shows the added amounts of Superester A125, the peeling forces at an ordinary temperature (about 23°C) and at an elevated temperature (about 70°C), and the rate of decrease of the peeling force from the value exhibited at the elevated temperature relative to the value exhibited at the ordinary temperature.

30

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(Example 9)

A wafer retainer with a double-sided adhesive tape was produced in the same manner as in Example 1 except that
5 an acrylic type adhesive (R5542 manufactured by Ipposha Oil Industry Co., Ltd) was used as a commercially available pressure-sensitive adhesive.

Next, the same polishing test as that in Example 1
10 was conducted, whereafter each wafer retainer was peeled. Table 2 shows the peeling forces at an ordinary temperature (about 23°C) and at an elevated temperature (about 60°C), and the rate of decrease of the peeling force from the value exhibited at the elevated temperature relative to that
15 exhibited at the ordinary temperature.

(Example 10)

A wafer retainer with a double-sided adhesive tape was produced in the same manner as in Example 1 except that
20 an acrylic type pressure-sensitive adhesive (AR-2108M-1, manufactured by RIKIDYNE Co., Ltd.) was used as a commercially available pressure-sensitive adhesive.

Next, the same polishing test as that in Example 1
25 was conducted, whereafter each wafer retainer was peeled. Table 2 shows the peeling forces at an ordinary temperature (about 23°C) and at an elevated temperature (about 60°C), and the rate of decrease of the peeling force from the value exhibited at the elevated temperature relative to that
30 exhibited at the ordinary temperature.

(Comparative Example)

A wafer retainer with a double-sided adhesive tape

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was produced in the same manner as in Example 1 except that a commercially available double-sided adhesive tape (ST442 manufactured by Sumitomo 3M Ltd.) was attached on the polyester film 50 of the backing film. Next, the wafer
5 retainer was evaluated by using a single-side polishing machine (SPM-19, manufactured by Fujikoshi Kikai) in the same manner as in Example 1.

Wafers of silicon monocrystal P (100) (diameter:
10 6 inches) were subjected to a polishing under the polishing conditions described in Table 4. Specifically, fifty times of polishing (about 30 minutes each time) were repetitively performed. After the wafer retainer was used in the above-mentioned manner, the wafer retainer was detached from
15 the ceramic upper base plate. The wafer retainer required a maximum peeling force of about 40 Kg, and therefore was not easy to peel off. The peeling force required at an elevated temperature was about 30 Kg at maximum.

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Table 1

Polishing machine	Speed fam Single-side polishing machine (59SPAW) with a base plate (diameter: 59 inches)
Wafer to be processed	Silicon monocrystal P (100) wafer (diameter: 8 inches)
Wafer retainer	SUBA800
Polishing slurry	NALCO2350; diluted by 20 times (manufactured by Nalco Chemical Company)
Processing pressure	300 g/cm ²
Slurry flow rate	1000 ml/min.
Processing time	30 min.

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Table 2

	Added amount (wt.%)	Peeling Force			Rate of decrease (%)
		23°C	60°C	70°C	
Example 1	0	30	3		90
Example 2	10	33	3.5		89
Example 3	20	42	3.5		92
Example 4	30	45	3.5		92
Example 5	0	28		3	89
Example 6	10	33		3.5	89
Example 7	20	40		3.5	91
Example 8	30	43		3.5	92
Example 9	0	30	3		90
Example 10	0	30	3		90
Comparative Example	-	40		30	25

5

Table 3

Ester-type polyurethane (CRISVON-7667; manufactured by Dainippon Ink and Chemicals, Inc.)	100 phr
dimethylformamide (manufactured by Nitto Chemical Industry Co., Ltd.)	50 phr
pigment(DILAC-5442; manufactured by Dainippon Ink and Chemicals, Inc.)	20 phr
surfactant(K ASSISTOR SD-7; manufactured by Dainippon Ink and Chemicals, Inc.)	3 phr

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Table 4

Polishing machine	Single-side polishing machine (SPM-19; manufactured by Fujikoshi Kikai) with a carrier plate (diameter: 485 mm)
Wafer to be processed	Silicon monocrystal P (100) wafer (diameter: 6 inches)
Polishing cloth	SUBA 800
Polishing slurry	NALCO2350; diluted by 20 times
Processing pressure	300 g/cm ²
Slurry flow rate	500 ml/min.
Processing time	30 min.

5

INDUSTRIAL APPLICABILITY

The exchanging or replacement of a wafer retainer according to the present invention, conducted after each polishing process, is facilitated because the wafer retainer can be easily peeled off a base plate surface simply by heating the base plate and/or the adhesive layer of the wafer retainer.

Various other modifications will be apparent to and can be readily made by those skilled in the art without departing from the scope and spirit of this invention. Accordingly, it is not intended that the scope of the claims appended hereto be limited to the description as set forth herein, but rather that the claims be broadly construed.

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CLAIMS

1. A wafer retainer comprising:

5 a foam layer capable of adsorbing a wafer on a surface thereof in a detachable manner;

a first pressure-sensitive adhesive layer formed on a back face of the foam layer;

10 a support formed on a back face of the first pressure-sensitive adhesive layer;

a second pressure-sensitive adhesive layer formed on a back face of the support for adhering to a base plate of a polishing machine; and

a release sheet releasably attached to the second pressure-sensitive adhesive layer,

15 wherein the second pressure-sensitive adhesive layer comprises an adhesive composition,

20 the adhesive composition containing a pressure-sensitive adhesive and a side-chain crystallizable polymer so that the side-chain crystallizable polymer is present in an amount of about 1% to about 30% by weight based on the adhesive composition, and

25 the side-chain crystallizable polymer including as a main component thereof an acrylic acid ester and/or methacrylic acid ester which has a straight-chain alkyl group including 16 or more carbon atoms as a side chain.

2. A wafer retainer according to claim 1,

wherein the adhesive composition contains a tackifier in an amount of about 10% to about 30% by weight; and

30 wherein adhesiveness of the adhesive composition is decreased by more than about 90% when heated above about 50°C.

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3. A wafer retainer according to claim 1, wherein the side-chain crystallizable polymer has a molecular weight of about 2,000 to about 15,000.

5 4. A wafer retainer according to claim 1, wherein the side-chain crystallizable polymer has a melting point which occurs within a temperature range narrower than about 15°C.

5. A wafer retainer comprising:

10 a wafer retention layer capable of adsorbing a wafer on a surface thereof in a detachable manner;

a pressure-sensitive adhesive layer for attaching the wafer retention layer to a base plate of a polishing machine; and

15 a release sheet releasably attached to the pressure-sensitive adhesive layer,

wherein the pressure-sensitive adhesive layer comprises an adhesive composition,

20 the adhesive composition containing a pressure-sensitive adhesive and a side-chain crystallizable polymer so that the side-chain crystallizable polymer is present in an amount of about 1% to about 30% by weight based on the adhesive composition, and

25 the side-chain crystallizable polymer including as a main component thereof an acrylic acid ester and/or methacrylic acid ester which has a straight-chain alkyl group including 16 or more carbon atoms as a side chain.

6. A wafer retainer according to claim 5,

30 wherein the adhesive composition contains a tackifier in an amount of about 10% to about 30% by weight; and

wherein adhesiveness of the adhesive composition is decreased by more than about 90% when heated above about

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50°C.

7. A wafer retainer according to claim 5, wherein the side-chain crystallizable polymer has a molecular weight of about 2,000 to about 15,000.

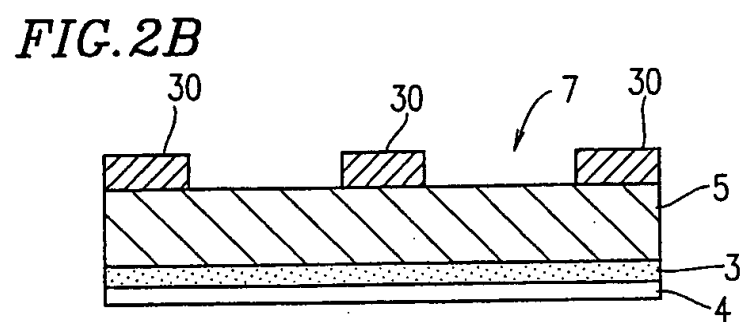
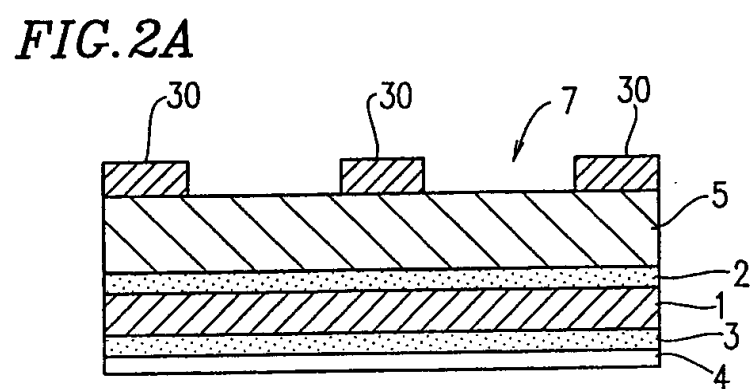
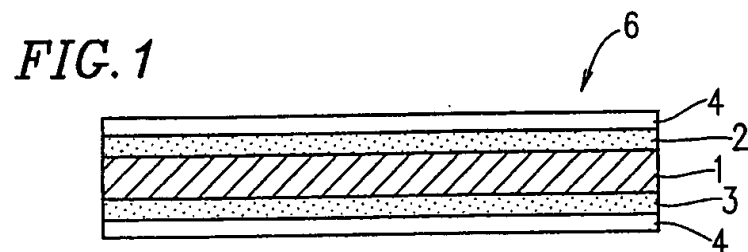
8. A wafer retainer according to claim 5, wherein the side-chain crystallizable polymer has a melting point which occurs within a temperature range narrower than about 15°C.

9. A method for attaching/detaching a wafer retainer according to claim 1 to/from a base plate of a polishing machine, comprising the steps of:

attaching the wafer retainer to the base plate of the polishing machine by allowing the pressure-sensitive adhesive of the wafer retainer to adhere to the base plate surface maintained at temperature T1; and

detaching the wafer retainer from the base plate maintained at temperature T2 which is higher than temperature T1.

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FIG. 3

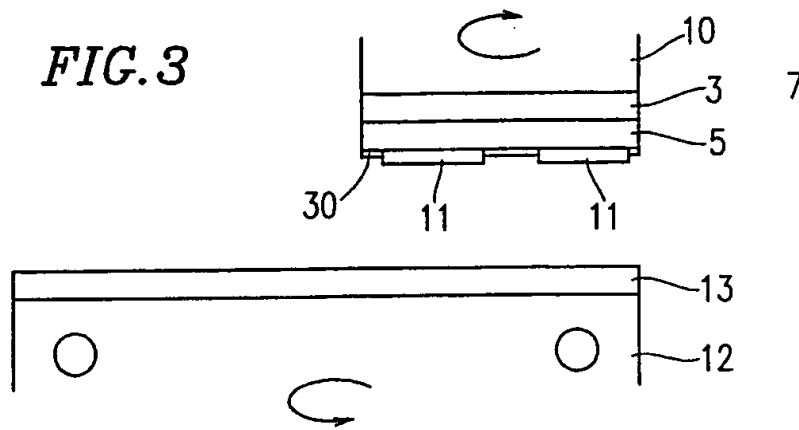
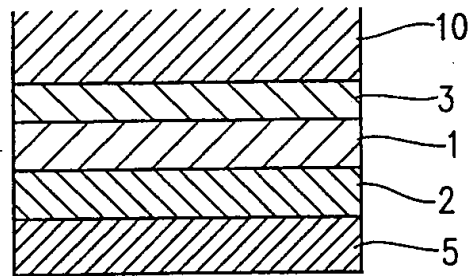


FIG. 4



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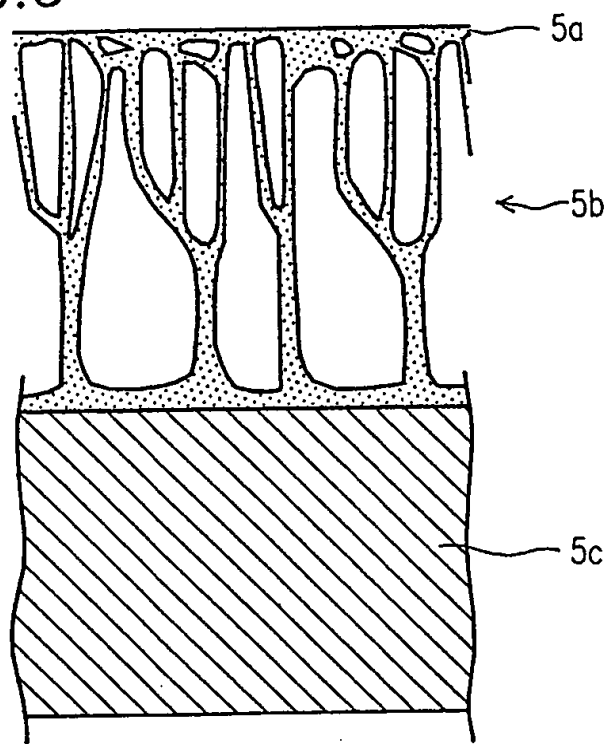
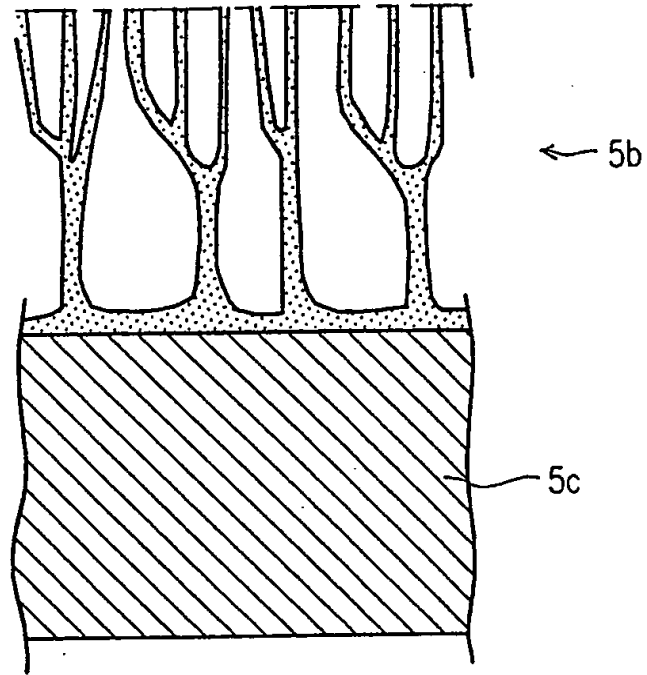
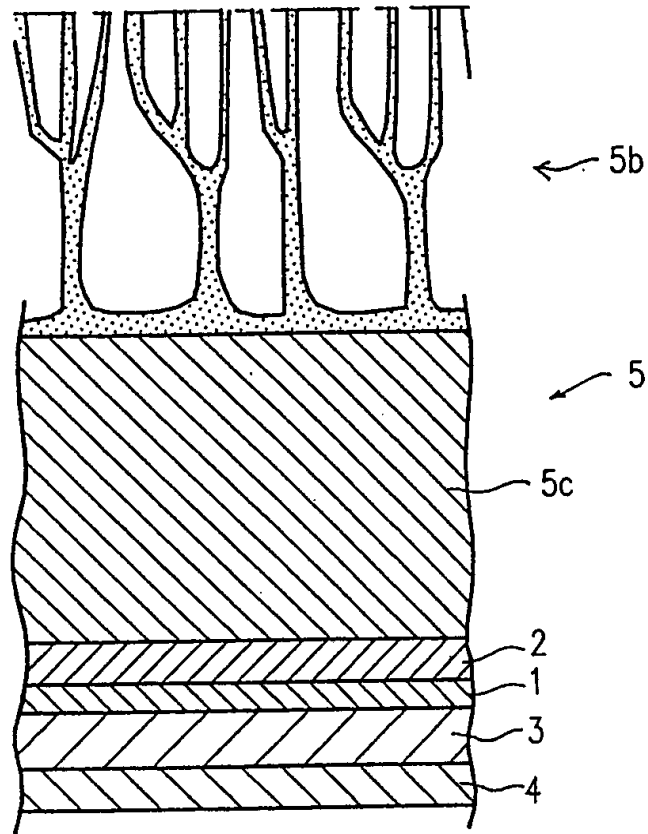
FIG. 5

FIG. 6



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FIG. 7



INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP 99/04661

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C09J7/02 H01L21/68 B24B37/04 B24B41/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 C09K C09J H01L B24B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	WO 96 30163 A (NITTA CORP ;ISHII HIDEYUKI (JP); SHIGETA YOSHITANE (JP)) 3 October 1996 (1996-10-03) the whole document ---	1-9
Y	WO 92 13901 A (LANDEC LAB INC) 20 August 1992 (1992-08-20) cited in the application example 47 claims 1-7,10,11 ---	1-9
A	US 4 512 113 A (BUDINGER WILLIAM D) 23 April 1985 (1985-04-23) figure 2 column 2, line 45 - line 63 column 3, line 14 - line 39 --- -/-	1,5

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

5 January 2000

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP 99/04661

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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